CLAIMS

1.   A packet communication network comprising:

at least two full-mesh wavelength-division-multiplexing transmission units, each of which includes n
5   number of interfaces, and is capable of establishing a bidirectional full-mesh communication between all of the interfaces using a wavelength path based on a wavelength-division-multiplexing technique, where n is an integer equal to or greater than 3;
10   an edge-packet transfer unit that includes at least a packet recognizing unit, an external-packet transmitting/receiving unit, and an internal-packet transmitting/receiving unit, and is connected to the interface of the full-mesh wavelength-division-multiplexing
15   transmission unit; and

an internetwork connection unit that includes at least a packet recognizing unit and a packet transmitting/receiving unit, and connects the full-mesh wavelength-division-multiplexing transmission units in a
20   multistage tree-shaped structure through the edge-packet transfer units, wherein

the packet recognizing units of the edge-packet transfer unit and the internetwork connection unit identify the edge-packet transfer unit that is a destination of a
25   packet from a header of the packet,

the external-packet transmitting/receiving unit of the edge-packet transfer unit inputs a packet received from outside to the internal-packet transmitting/receiving unit, and transmits a packet output from the internal-packet
30   transmitting/receiving unit to the outside,

the internal-packet transmitting/receiving unit of the edge-packet transfer unit transmits the packet input from the external-packet transmitting/receiving unit to the

wavelength path of the full-mesh wavelength-division-multiplexing transmission unit corresponding to the edge-packet transfer unit that is the destination of the packet identified by the packet recognizing unit, if the

5 destination of the packet identified by the packet recognizing unit is other edge-packet transfer unit connected to the full-mesh wavelength-division-multiplexing transmission unit, transmits the packet input from the external-packet transmitting/receiving unit to the

10 wavelength path of the full-mesh wavelength-division-multiplexing transmission unit corresponding to the other edge-packet transfer unit, and if the destination of the packet identified by the packet recognizing unit is the edge-packet transfer unit of its own or the edge-packet

15 transfer unit that is not connected to the full-mesh wavelength-division-multiplexing transmission unit, transmits the packet input from the external-packet transmitting/receiving unit to the external-packet transmitting/receiving unit, and

20 the packet transmitting/receiving unit of the internetwork connection unit transmits the packet received from the edge-packet transfer unit to the edge-packet transfer unit that is the destination of the packet identified by the packet recognizing unit.

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2.   The packet communication network according to claim 1, wherein
      the full-mesh wavelength-division-multiplexing transmission units include physically-independent plural

30 full-mesh wavelength-division-multiplexing transmission units arranged in parallel,
        the edge-packet transfer unit includes
            a first edge-packet transfer unit connected to

one of the full-mesh wavelength-division-multiplexing transmission units and the internetwork connection unit; and

a second edge-packet transfer unit connected to all of the full-mesh wavelength-division-multiplexing transmission units,

the internetwork connection unit includes a switching unit that is provided on an input side of the packet transmitting/receiving unit and switches over destinations of a plurality of packets received from a plurality of first edge-packet transfer units connected to the full-mesh wavelength-division-multiplexing transmission units, respectively, to determine a plurality of other first edge-packet transfer units connected to a plurality of other full-mesh wavelength-division-multiplexing transmission units that are the destinations of the packets, and

the internal-packet transmitting/receiving unit of the second edge-packet transfer unit transmits the packet input from the external-packet transmitting/receiving unit simultaneously to same-wavelength paths of the full-mesh wavelength-division-multiplexing transmission units corresponding to the first edge-packet transfer unit or the second edge-packet transfer unit that is the destination of the packet identified by the packet recognizing unit, if the destination of the packet identified by the packet recognizing unit is other first edge-packet transfer unit or second edge-packet transfer unit connected to the full-mesh wavelength division multiplexing units, transmits a plurality of packets input from the same-wavelength paths of the full-mesh wavelength-division-multiplexing transmission units simultaneously to the same-wavelength paths of the full-mesh wavelength division multiplexing units corresponding to the other first edge-packet transfer

unit or second edge-packet transfer unit, and if the destination of the packet identified by the packet recognizing unit is the second edge-packet transfer unit itself or first edge-packet transfer unit or second edge-

5   packet transfer unit that is not connected to the full-mesh wavelength division multiplexing units, selects one of the packets, and transmits the selected packet to the external-packet transmitting/receiving unit.

10   3.   The packet communication network according to claim 2, wherein

      the internetwork connection unit includes an important communication processing unit that extracts and compares important communication packets from the packets received

15   from the first edge transfer units connected to the wavelength division multiplexing transmission units, respectively, and if there is a packet loss in one packet, copies other packet corresponding the one packet.

20   4.   The packet communication network according to claim 1, wherein

      the edge-packet transfer unit includes

          a packet recognizing unit that identifies the edge-packet transfer unit that is the destination of the

25   packet and a service from a header of the packet; and

          a packet processing unit that processes the packet received from the external-packet transmitting/receiving unit into a packet form for a communication method used by the full-mesh wavelength-

30   division-multiplexing transmission unit if a communication method corresponding to the service identified by the packet recognizing unit differs from the communication method used by the full-mesh wavelength-division-

multiplexing transmission unit, and processes the packet
input from the full-mesh wavelength-division-multiplexing
transmission unit to the internal-packet
transmitting/receiving unit and output to the external-

5   packet transmitting/receiving unit into the packet form for
the communication method corresponding to the service
identified by the packet recognizing unit if the
communication method corresponding to the service differs
from the communication method used by the full-mesh

10   wavelength division multiplexing unit.

5.   The packet communication network according to claim 4,
further comprising:
        a gateway unit that connects a specific edge-packet

15   transfer unit and an external network, wherein
        the packet processing unit of the specific edge-packet
transfer unit processes the packet output to the external-
packet transmitting/receiving unit into the packet form for
the communication method corresponding to the service

20   identified by the packet recognizing unit if the service is
a service for connecting the specific edge-packet transfer
unit and the external network, and
        the external-packet transmitting/receiving unit
transmits the processed packet to the gateway unit

25   corresponding to the external network.

6.   The packet communication network according to claim 1,
wherein
        the edge-packet transfer unit includes

30   a resource management unit that manages resource
states of all of the wavelength paths related to an
interface of each of the full-mesh wavelength-division-
multiplexing transmission units, the interface connecting

the edge-packet transfer unit; and

a resource-information transfer unit that transfers information on the resource states as a packet.

5   7.   The packet communication network according to claim 6, wherein

when transmitting the packet input from the external-packet transmitting/receiving unit or the full-mesh wavelength division multiplexing unit, the destination of

10   which identified by the packet recognizing unit is the other edge-packet transfer unit connected to the full-mesh wavelength-division-multiplexing transmission unit, to the wavelength path of the full-mesh wavelength-division-multiplexing transmission unit corresponding to the other

15   edge-packet transfer unit, the internal-packet transmitting/receiving unit of the edge-packet transfer unit transmits the packet to other wavelength path if the resource state of the wavelength path is determined to be equal to or higher than a threshold based on resource state

20   information on the wavelength path managed by the resource management unit.

8.   The packet communication network according to claim 6, wherein

25   in a communication for exercising a call admission control by transmitting a call control packet of a call request or a call response to a control server that includes a call-admission control unit, the external-packet transmitting/receiving unit or the internal-packet

30   transmitting/receiving unit of the edge-packet transfer unit adds resource state information managed by the resource management unit to the call control packet when a type of the packet identified by the packet recognizing

unit is the call control packet.

9.   A packet communication method using

at least two full-mesh wavelength-division-

5   multiplexing transmission units, each of which includes n

number of interfaces, and is capable of establishing a

bidirectional full-mesh communication between all of the

interfaces using a wavelength path based on a wavelength-

division-multiplexing technique, where n is an integer

10   equal to or greater than 3;

an edge-packet transfer unit that includes at least a

packet recognizing unit, an external-packet

transmitting/receiving unit, and an internal-packet

transmitting/receiving unit, and is connected to the

15   interface of the full-mesh wavelength-division-multiplexing

transmission unit; and

an internetwork connection unit that includes at least

a packet recognizing unit and a packet

transmitting/receiving unit, and connects the full-mesh

20   wavelength-division-multiplexing transmission units in a

multistage tree-shaped structure through the edge-packet

transfer units, the packet communication method comprising:

first packet transmitting including

the packet recognizing unit of the edge-packet

25   transfer unit identifying the edge-packet transfer unit

that is a destination of a packet with respect to a packet

received by the external-packet transmitting/receiving

unit; and

the internal-packet transmitting/receiving unit

30   of the edge-packet transfer unit transmitting the packet to

the wavelength path of the full-mesh wavelength-division-

multiplexing transmission unit corresponding to the

destination of the packet; and

second packet transmitting including

the packet recognizing unit of the edge-packet transfer unit on the other side of the wavelength path identifying the edge-packet transfer unit that is the

5   destination of the packet received by the internal-packet transmitting/receiving unit;

the external-packet transmitting/receiving unit or the internal-packet transmitting/receiving unit corresponding to the destination of the packet transmitting

10   the packet, and when the external-packet transmitting/receiving unit is connected to the internetwork connection unit, the internetwork connection unit transmitting the packet to the edge-packet transfer unit corresponding to the destination of the packet; and

15   repeating the first packet transmitting and the second packet transmitting until the packet is output from the edge-packet transfer unit corresponding to the destination of the packet.

20   10. The packet communication method according to claim 9, wherein

the full-mesh wavelength-division-multiplexing transmission units include physically-independent plural full-mesh wavelength-division-multiplexing transmission

25   units arranged in parallel,

the edge-packet transfer unit includes

a first edge-packet transfer unit connected to one of the full-mesh wavelength-division-multiplexing transmission units and the internetwork connection unit;

30   and

a second edge-packet transfer unit connected to all of the full-mesh wavelength-division-multiplexing transmission units,

the internetwork connection unit includes a switching
unit that is provided on an input side of the packet
transmitting/receiving unit and switches over destinations
of a plurality of packets received from a plurality of
5   first edge-packet transfer units connected to the full-mesh
wavelength-division-multiplexing transmission units,
respectively, to determine a plurality of other first edge-
packet transfer units connected to a plurality of other
full-mesh wavelength-division-multiplexing transmission
10   units that are the destinations of the packets, and
the packet communication method further comprises:
third packet transmitting including
the internal-packet transmitting/receiving
unit of the second edge-packet transfer unit transmitting
15   the packet input from the external-packet
transmitting/receiving unit simultaneously to same
wavelength paths of the plurality of parallel full-mesh
wavelength-division-multiplexing transmission units;
the internetwork connection unit selecting a
20   packet to be transmitted by changing a communication
configuration between the full-mesh wavelength-division-
multiplexing transmission units according to the switching
unit of the internetwork connection unit switching over
paths from the first edge-packet transfer units to other
25   first edge transfer units that are the destinations of the
packet; and
performing a redundant packet communication by
the internal-packet transmitting/receiving unit of the
second edge-packet transfer unit corresponding to the
30   destination of the packet selecting a packet received from
the full-mesh wavelength-division-multiplexing transmission
units and transmitting the selected packet.

11.   The packet communication method according to claim 10, wherein

        the internetwork connection unit includes an important communication processing unit, and

5   the packet communication method further comprises:

        the important communication processing unit extracting and comparing important communication packets from the packets received from the first edge transfer units connected to the wavelength division multiplexing

10   transmission units, respectively; and

        performing the redundant packet communication by copying, if there is a packet loss in one packet, other packet corresponding the one packet.

15   12.   The packet communication method according to claim 9, wherein

        the edge-packet transfer unit includes a packet processing unit, and

        the packet communication method further comprises:

20   performing a packet communication, in which plural services are overlapped, by the packet processing unit processing the packet received from the external-packet transmitting/receiving unit into a packet form for a communication method used by the full-mesh wavelength-

25   division-multiplexing transmission unit if a communication method corresponding to the service identified by the packet recognizing unit differs from the communication method used by the full-mesh wavelength-division-multiplexing transmission unit, and processing the packet

30   input from the full-mesh wavelength-division-multiplexing transmission unit to the internal-packet transmitting/receiving unit and output to the external-packet transmitting/receiving unit into the packet form for

the communication method corresponding to the service
identified by the packet recognizing unit if the
communication method corresponding to the service differs
from the communication method used by the full-mesh
5   wavelength division multiplexing unit.

13.   The packet communication method according to claim 12,
wherein
        the packet communication method further uses a gateway
10   unit that connects a specific edge-packet transfer unit and
an external network, and
        the packet communication method further comprises:
            the packet processing unit of the specific edge-
packet transfer unit processing the packet output to the
15   external-packet transmitting/receiving unit into the packet
form for the communication method corresponding to the
service identified by the packet recognizing unit if the
service is a service for connecting the specific edge-
packet transfer unit and the external network; and
20   the external-packet transmitting/receiving unit
transmitting the processed packet to the gateway unit
corresponding to the external network.

14.   The packet communication method according to claim 9,
25   wherein
        the edge-packet transfer unit includes a resource
management unit and a resource-information transfer unit,
and
        the packet communication method further comprises:
30   the resource management unit managing resource
states of all of the wavelength paths related to the
interfaces of each of the full-mesh wavelength-division-
multiplexing transmission units to which interfaces the

each edge-packet transfer unit is connected; and

the resource-information transfer unit transferring information on each of the resource states as a packet.

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15. The packet communication method according to claim 14, further comprising:

the internal-packet transmitting/receiving unit of the edge-packet transfer unit transmitting, when transmitting

10 the packet input from the external-packet transmitting/receiving unit or the full-mesh wavelength division multiplexing unit, the destination of which identified by the packet recognizing unit is the other edge-packet transfer unit connected to the full-mesh

15 wavelength-division-multiplexing transmission unit, to the wavelength path of the full-mesh wavelength-division-multiplexing transmission unit corresponding to the other edge-packet transfer unit, the packet to other wavelength path if the resource state of the wavelength path is

20 determined to be equal to or higher than a threshold based on resource state information on the wavelength path managed by the resource management unit.

16. The packet communication method according to claim 14,

25 further comprising:

the external-packet transmitting/receiving unit or the internal-packet transmitting/receiving unit of the edge-packet transfer unit adding resource state information managed by the resource management unit to a call control

30 packet when a type of the packet identified by the packet recognizing unit is the call control packet, in a communication for exercising a call admission control by transmitting the call control packet of a call request or a

call response to a control server that includes a call-admission control unit.